COMPARATIVE STUDY OF INTRAVENOUS REGIONAL ANAESTHESIA LIGNOCAINE WITH KETOROLAC Vs PLAIN LIGNOCAINE

A STUDY OF 50 CASES

DISSERTATION SUBMITTED FOR

DOCTOR OF MEDICINE
BRANCH X
(ANAESTHESIOLOGY)

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CERTIFICATE

This is to certify that this dissertation entitled "A COMPARATIVE STUDY OF INTRAVENOUS REGIONAL ANAESTHESIA LIGNOCAINE WITH KETOROLAC Vs PLAIN LIGNOCAINE" submitted by DR.D.S.SUDHAKAR to the faculty of ANAESTHESIOLOGY, The TamilNadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement in the award of degree of M.D.Degree, Branch -X (ANAESTHESIOLOGY), for the March 2007 examination is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

I, Dr.D.S.SUDHAKAR declare that the dissertation titled "A COMPARATIVE STUDY OF INTRAVENOUS REGIONAL ANAESTHESIA LIGNOCAINE WITH KETOROLAC Vs PLAIN LIGNOCAINE" has been prepared by me.

This is submitted to The Tamil Nadu Dr. M.G.R. Medical University, Chennai, in partial fulfilment of the requirement for the award of M.D.Degree,Branch X(ANAESTHESIOLOGY) degree Examination to be held in March 2007.

Place : Madurai

Date : **Dr. D.S. SUDHAKAR**

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CONTENTS

INTRODUCTION

IntraVenous Regional Anaesthesia (IVRA) since its birth in the hands of August Bier in 1908 has become a valuable instrument in the repertoire of anaesthesia providers. This method enjoyed wide popularity for a time. It is not long before simple and reliable techniques for brachial plexus developed, and the intravenous method declined in popularity.

It was revived in 1963 by Holmes, who used lignocaine because it appeared to give more reliable anaesthesia than procaine. With slight technical modifications IVRA, today, is an ideal method of providing anaesthesia for minor surgical procedures to the extremities performed on an ambulatory basis. It has the advantages of speed of onset, rapid recovery, reliability of blockade & cost effectiveness.

Adjuvants to local anaesthetics have greatly expanded the potential applications of regional anaesthesia by providing faster onset time, inhibition of tourniquet pain, prolonged post-operative anaesthesia and improved peri-operative analgesia apart from decreasing risk of local anaesthetic toxicity.

In this regard, ketorolac – a parenterally administered NSAID by decreasing tissue prostaglandin (PG) synthesis, decrease peri-operative pain in combination with LA. Being a peripherally acting drug, not crossing the blood brain barrier in significant degree, it has the specific advantage of minimal CNS side effects.

Cumulative effects of these agents result in greater patient satisfaction, rapid hospital discharge , cost effectiveness and minimal risks.

AIMS OF THE STUDY

1. To prove the effectiveness of ketorolac as an adjuvant in intravenous regional anaesthesia
2. To know the effect of ketorolac on the tourniquet pain & post operative analgesia in IVRA

REVIEW OF LITERATURE

1. A systematic review of adjuncts for intravenous regional anaesthesia for surgical procedures. Andrew Choyce MBCHB FRCA and Philip Peng, MBBS FRCPC. From the Department of Anaesthesia, King's college Hospital, Denmark Hill, London, UK and the Toronto Western Hospital, Canada.

The authors tested the use of adjuncts for intravenous regional anaesthesia (IVRA) for surgical procedures in terms of their intraoperative effects and postoperative analgesia.

They concluded that, there is good evidence to recommend NSAIDS in general and ketorolac in particular for improving post operative analgesia after IVRA. Clonidine also appears to improve post operative analgesia and prolong tourniquet tolerance. Opioids are disappointing by this route. Only 30 mg meperidine has substantial postoperative benefit but at the expense of post deflation side effects. Muscle relaxants improve motor block and aid fracture reduction.

2. An evaluation of the analgesic efficacy of intravenous regional anaesthesia with lidocaine and ketorolac using a forearm versus upper arm tourniquet. Scott s. Reuben, MD., Robert B. Steinberg, MD, PhD, Holly Maciolek, RN and Poornachandran Manikantan MD, Department of Anaesthesiology, Tuffs University School of Medicine, Massachusetts.

In this study, they assessed the analgesic efficacy of administering IVRA by administrating lidocaine and ketorolac with either a forearm or upper arm tourniquet for outpatient hand surgery. They concluded that forearm tourniquet intravenous regional anaesthesia with 0.5% lidocaine and ketorolac provides both a longer duration of sensory block and prolonged postoperative analgesia compared with upper arm IVRA.

3. Local anaesthetic adjuvants for neuraxial and peripheral blockade – James R. Hebl, MD, Department of Anaesthesiology Mayo – clinic, USA.

In this study, they studied about various local anaesthetic additives such as opioids, alpha – 2 agonists (clonidine), acetylcholine esterase inhibitors(neostigmine) and N methyl – D aspartate receptor antagonists (Ketamine) and NSAIDS

They demonstrated that more effective postoperative analgesia can be achieved when Ketorolac is used in conjunction with lidocaine for IVRA. They hypothesized that more effective analgesia was obtained during IVRA administration because a higher concentration of ketorolac existed at the site of surgical trauma, where inflammatory mediator synthesis occurred.

4. Comparision of wound infiltration with ketorolac Versus intravenous regional anaesthesia with ketorolac for postoperative analgesia following ambulatory hand surgery.

- Reuben SG, Duprat MM, Tufts University school of Medicine, spring field, Massachusetts, USA.

The purpose of this study was to assess the analgesic effectiveness of ketorolac administered with lidocaine via intravenous regional anaesthesia (IVRA) or via wound infiltration following ambulatory hand surgery. They concluded that ketorolac provides similar postoperative analgesia after ambulatory hand surgery when administered with lidocaine either by IVRA or by wound infiltration.

5. Intravenous Regional Anaesthesia using prilocaine and neostigmine

A. Turan, B. Karamanlyog M, D. Memis, G. Kaya and Z. Paukcy ; Department of Anaesthesiology and Reanimation, Trakya University, Turkey.

In this study, thirty patients undergoing hand surgery were randomly assigned to two groups to receive IVRA. They have used 0.5 mg of neostigmine as a additive. They found shortened sensory and motor block onset times, improved quality of anaesthesia and prolonged sensory and motor block recovery times, and prolonged time to first analgesic requirement were found in neostigmine group.

6. 0.5 % versus 1.0% 2 – chloroprocaine for Intravenous Regional Anaesthesia : A prospective randomized, Double – Blind Trial.

Stephan C. Marsch, MD, D Phil, Mathias Sluga, MD, Wolfgang studer, MD, Jonas Barandun, MD, Domenic Scharplatz, MD and wolf gang Ummentioter MD, From the Departments of Anaesthesia and surgery, Switzerland.

In this randomised prospective double – blind study they tested the hypothesis that compared with 40 ml chloroprocaine 0.5 %, 40 ml chloroprocaine 1 % results in an earlier onset of analgesia duration and improves distal tourniquet tolerance during IV reginal anaesthesia. These beneficial effects must be weighed against a fourfold increase in signs of systemic local anaesthetic toxicity.

INTRAVENOUS REGIONAL ANAESTHESIA

Intravenous regional anaesthesia (IVRA) was first described by August Bier in 1908. He observed that when local anaesthetic was injected intravenously between two tourniquets on a limb, a rapid onset of anaesthesia occurred in the area between the tourniquets and a slower onset occurred beyond the distal tourniquet. The technique did not become popular until the 1960s when it was reintroduced by Holmes. Today, the technique is slightly modified, using either a single or a double tourniquet at one site and injecting local anaesthetic as distal as possible to the cuff. The double tourniquet is used to increase safety and to reduce tourniquet pain in the awake patient, but there is a possibility of accidental deflation of the wrong cuff, which may lead to toxic systemic levels of local anaesthetic.

IVRA is technically simple and does not require specific anatomical knowledge. Success rate is 96–100% with a low incidence of side-effects. It is a reliable, simple and safe method of providing anaesthesia for minor surgical procedures to the extremities if it is administered by experienced clinicians

Advantages and Disadvantages of intravenous regional anaesthesia

Advantages :

- Speed of onset and rapid recovery
- Reliability (in the absence of local infection and with adequate equipment)
- Muscle relaxation
- Technical simplicity

Disadvantages and Complications

- Poor postoperative analgesia
- Limited time of surgical anaesthesia (< 90 minutes)
- The potential of systemic local anaesthetic toxicity
- Nerve damage secondary to direct compression by the tourniquet
- Compartment syndrome and loss of limb (very rare)

Mechanisms of action:

Local anaesthetic diffuses into the small veins surrounding the nerves and then into the vasa nervorum and capillary plexus of the nerves, leading to a core to mantle (centrifugal) conduction block in the nerves involved. Local anaesthetic then diffuses into the small nerves in the skin, blocking

their conduction. The tourniquet produces ischaemia, which contributes to the analgesic action of the local anaesthetic by blocking nerve conduction and motor endplate function. 20 minutes after tourniquet application alone there will be analgesia to pinprick without the injection of any local anaesthetic. However, the speed of onset and the density of anaesthesia are greater with injection of local anaesthetic.

Indications:

IVRA is used for surgical interventions on the hand, forearm or elbow that will not exceed 1 hour. These include manipulation of forearm fractures, excision of wrist ganglia and palmar fasciotomy. IVRA is particularly useful for tendon grafting because it enables the surgeon to observe movement and tension of the grafted tendon (after deflating the tourniquet) before closing the wound (continued anaesthesia with a wrist block). IVRA can also be used for surgery on the foot, ankle or lower leg, for example for removing plates, screws or foreign bodies. Surgery on the elbow or knee is poorly tolerated using IVRA.

Contraindications are mainly related to tourniquet use. Absolute contraindications include sickle cell disease, Raynaud's disease or scleroderma, allergy to local anaesthetics and patient refusal. Relative contraindications include severe hypertensive or peripheral vascular

disease, local infection, and skeletal muscle disorders or Paget's disease (local anaesthetic may spread to the systemic circulation via venous channels in bone).

Procedure

Before the procedure the patient should be:

- ❖ starved for 6 hours
- ❖ monitored closely (standard monitoring applied)
- ❖ placed on a tipping trolley
- ❖ adequately informed about the procedure and have consented to it.

The equipment required for IVRA includes:

- ❖ pneumatic tourniquet (checked for leaks before the procedure) and a pressure gauge
- ❖ Esmarch bandage or Rhys-Davis exsanguinator
- ❖ local anaesthetic solution
- ❖ resuscitation equipment and drugs.

IVRA of the arm:

A 22 G cannula is placed intravenously as distal as possible in the arm to be anaesthetized. Venous access is established in the opposite arm to allow administration of fluids or drugs if necessary. The double tourniquet

(two tourniquets each 6 cm wide) or a single one (14 cm wide) is applied on the arm with generous layers of padding, ensuring that no wrinkles are formed and the tourniquet edges do not touch the skin. The arm is exsanguinated either by using the Esmarch bandage or a Rhys-Davis exsanguinator. If this is impossible, exsanguination can be achieved by elevating the arm for 2–3 minutes while compressing the axillary artery. The distal tourniquet is inflated to at least 100 mmHg higher than the patient's systolic blood pressure (250–300 mmHg). The proximal tourniquet is inflated to the same pressure. After ensuring inflation, the distal cuff is deflated.

Before injecting local anaesthetic it must be confirmed that no radial pulse is palpable. The local anaesthetic is then injected slowly. A standard volume for injection into the upper limb is 40 ml, which can be increased to 50 ml in a fit, large adult. If the injection is too rapid, the venous pressure may exceed the tourniquet pressure and the local anaesthetic solution may escape into the systemic circulation. Surgical anaesthesia is usually achieved within 15 minutes. The distal tourniquet, which overlies part of the anaesthetized arm, can then be inflated and the proximal one deflated to relieve tourniquet pain.

The cuff should not be deflated until 20 minutes after local anaesthetic injection because systemic toxic doses of local anaesthetic may occur. After 20 minutes, 30% of the injected drug is fixed within the tissues and is unavailable for immediate release into the systemic circulation. Cuff deflation should be performed in cycles with deflation/inflation times of less than 10 seconds until the patient no longer exhibits signs of systemic toxicity (e.g. tingling of the lips, tinnitus, drowsiness). Severe signs of systemic toxicity include bradycardia, hypotension, ECG abnormalities, seizures and loss of consciousness. Maximum blood levels of local anaesthesia occur within 10 minutes of cuff deflation. Therefore, the patient should be monitored closely for 30 minutes following tourniquet release. With lignocaine, 2.5–3 mg/kg, and cuff deflation after 10 minutes, blood levels have been reported to be less than 2 micrograms/ml.

If severe CNS intoxication occurs, appropriate resuscitation guidelines should be followed. Emergency drugs must be readily available and 100% oxygen should be administered.

IVRA of the leg:

The basic technique is the same as for the arm but the dose and volume of local anaesthetic has to be doubled for IVRA of the leg, which is associated with an increased potential for local anaesthetic toxicity. The

tourniquet pressure must be higher in the leg (350–400 mmHg), to occlude blood flow in the femoral artery. This may increase the occurrence of tourniquet pain. Tourniquets may be applied to the thigh (two tourniquets about 9 cm wide) or one at the calf (below the head of the fibula) and one at the thigh. The latter is for safety in case of distal cuff failure and is not usually inflated.

Choice of drugs

Many local anaesthetic drugs, with or without additives, have been used for IVRA, but 0.5% prilocaine, 3–6 mg/kg, is the drug of choice because it has less systemic toxicity and is partially taken up in the lungs before reaching the systemic circulation. The usual dose is 40 ml (200 mg) without epinephrine. However, the manufacturers have ceased production of 0.5% prilocaine. 1% prilocaine remains available and is licensed for IVRA, though its stability is not guaranteed if diluted. If prilocaine is unavailable and 0.5% lignocaine, 3 mg/kg, is used. If IVRA is applied to the leg a larger volume must be injected (up to 100 ml). Prilocaine can be used undiluted (maximum recommended dose is 400 mg in adults) but lignocaine is commonly diluted to lower concentrations (e.g. 0.2–0.25%).

Prilocaine can cause methaemoglobinaemia but unless doses in excess of 600 mg are used it is clinically insignificant in most patients. Although

one has to be aware that in patients with anaemia or cardiac conditions even small amounts of methaemoglobin can significantly impair the oxygen-carrying capacity of their red blood cells. Intravenous regional anaesthesia with prilocaine in these patients should be considered carefully for its benefits.

Other local anaesthetic agents have been used but do not provide superior analgesia or more rapid onset of block. Severe toxic reactions and death have been observed with bupivacaine and its use is contraindicated. In one study, 0.2% ropivacaine was intraoperatively as effective as 0.5% prilocaine but postoperative analgesia was prolonged;

Additives to local anaesthetics have not been consistently shown to have an effect during IVRA but may increase the length of postoperative analgesia, probably because of a systemic effect following tourniquet release. The reported enhancement of IVRA with pethidine, 1 mg/kg, may reflect intrinsic local anaesthetic activity of the drug.

Experiments with the addition of muscle relaxants produced marked muscle relaxation but did not augment analgesia.

Ketamine alone appears to provide good sensory analgesia but some patients lost consciousness and exhibited the typical features of ketamine anaesthesia after tourniquet release.

Many other drugs have been studied, but only the addition of clonidine, 150 micrograms, an α 2-agonist, or the non-steroidal anti-inflammatory drugs ketorolac, 20 mg, or tenoxicam, 20 mg, to the local anaesthetic solution appeared to be effective in prolonging postoperative analgesia and relieving tourniquet pain. Guanethidine and calcium-channel blockers have been evaluated in the context of chronic pain management only .

TOURNIQUET

Intravenous regional anaesthesia is a method of producing analgesia of the distal part of a limb by intravenous injection, while circulation to the limb is occluded.

Occlusion of the limb was done previously by winding an esmarch bandage proximally up the arm. Now occlusion of the limb was achieved by pneumatic tourniquet. Unfortunately, the tourniquet is not physiologic and is associated with number of disadvantages.

SITE OF APPLICAION:

The upper arm and thigh have sufficient muscle built to distribute the cuff pressure evenly and are recommended sites.

CUFF WIDTH:

The American Heart Association concluded that if a sphygmomanometer cuff has a width of 20% greater than the diameter of the upper arm or 40% of the circumference of the thigh (to a maximum of 20cm), then the pressure in the underlying central artery will be equal to that in the cuff. Modern silicone cuffs tend to be smaller than this, measuring 90mm width(bladder 70mm) for the arm and 105mm(bladder 75mm) for the leg.

The tissues immediately underlying the cuff should be protected with cotton wool. This is not necessary with correctly applied modern silicone cuff

PRESSURE:

It was based on the unsedated patient's blood pressure measured on the ward preoperatively. The recommended cuff pressure for the upper limb is systolic BP plus 100mmHg and for lower limb twice systolic BP. This higher pressure is needed because there is often not enough room above the operating site for full sized cuff.

TOURNIQUET TIME:

The recommended time for upper limb is 90minutes. Two hours should be regarded as a maximum but this will not be safe for all patients. Notify the surgeon about tourniquet time every half an hour.

CONTRAINDICATIONS:

-Sickle cell disease

-Raynaud's disease and other peripheral vascular disease

-Tumour or severe infection at the site of application

-Severe left ventricular failure

-Deep venous thrombosis- Massive total pulmonary embolism has been reported.

PHYSIOLOGIC CHANGES CAUSED BY LIMB TOURNIQUETS:

NEUROLOGIC EFFECTS:

-Abolition of somatosensory evoked potentials and nerve conduction occurs with in 30minutes

-Application for more than 60minutes causes tourniquet pain and hypertension

-Application for more than 2hours may result in postoperative neuropraxia

-Evidence of nerve injury may occur at a skin level underlying the edge of the tourniquet

MUSCLE CHANGES:

-Cellular hypoxia develops with in 8minutes

-Cellular creatine level declines

-Progressive cellular acidosis occurs

-Endothelial capillary leak develops after 2hours

-Limb becomes progressively colder

SYSTEMIC EFFECTS OF TOURNIQUET INFLATION:

Arterial and pulmonary artery pressures become elevated, although this effect is usually slight to moderate if only one limb is occluded

SYSTEMIC EFFECTS OF TOURNIQUET RELEASE:

-Transient fall in core temperature

-Transient metabolic acidosis

-Transient fall in central venous oxygen tension

-Rapid release of acid metabolites into central circulation

-Transient fall in pulmonary and systemic arterial pressures.

-Transient increase in end – tidal carbondioxide

-Increased oxygen consumption

TOURNIQUET PAIN:

Patients receiving spinal anaesthesia may develop a poorly defined aching or burning sensation in the distal extremity about one hour after tourniquet inflation. Although the mechanism and neural pathways for this severe aching and burning sensation defy precise explanation, unmyelinated , slow –conduction C fibres , which are relatively resistant to local anaesthetic blockade, probably play a critical role. Even during general anaesthesia, tourniquet pain can be revealed by a gradually increasing mean arterial blood pressure. The tourniquet pain and its accompanying hypertension influenced by many factors including anaesthetic technique (IVRA > Epidural> Spinal> GA), intensity and level of block, choice of local anaesthetic (hyperbaric spinal with tetracaine > isobaric bupivacaine), and supplementation of the block with opioids. Cuff deflation invariably

and immediately relieves the sensation of tourniquet pain and its hypertension. Systemic opioids has questionable value in relieving tourniquet pain.

PHARMACOLOGY OF LIGNOCAINE

Lignocaine is a synthetic amide-linked anaesthetic of intermediate potency and duration. In 1943 Lofgren synthesized Lignocaine in Sweden. First used by Gordh in 1948.

Lignocaine is the standard to which all other local anaesthetics are compared. It is currently the most widely used local anaesthetic. In addition, it is a popular antiarrythmic. It can be given by almost any route.

Mechanism of action :

Lignocaine prevent transmission of nerve impulses by inhibiting passage of sodium ions through ion-selective sodium channels in the nerve membranes. This slows the rate of depolarization such that the threshold potential is not reached and thus action potential is not propagated. But resting membrane potential is not altered. Lignocaine binds to the inner portion receptor (i.e Sodium channel) after entering the cell membrane.

Physiochemical properties :

Molecular weight 234

Weak base with a pka 7.6 – 7.8

Very stable, not decomposed by boiling, acids or alkalies

It is less lipid soluble than that of Bupivacaine

Pharmacokinetics :

Absorption :

It is absorbed from the site of application or injection into the blood stream. Rate of absorption depends on the blood flow to the area and use of epinephrine.

Metabolism :

Metabolised in liver by oxidative dealkylation to monoethylglycine xylidide followed by hydrolysis of this metabolite to xylidide. Metabolism is dependant on hepatic blood flow.

Monoethylglycine xylidide has 80% activity of the parent drug.

Xylidide has 10% activity of the parent drug.

75% of xylidide is excreted in the urine as 4 – hydroxyl – 2,6 – dimethylaniline.

Onset of action :

Rapid onset of action

- Topical anaesthesia 5-10 mins
- Conduction anaesthesia

  For small nerves 5-10 mins

  For large nerves 10-15 mins

- Intravenous administration 1-2 mins

Protein binding :

It is 70% bound to α 1 acid glycoproteins

Volume of distribution :

91 litres

Distribution :

Lignocaine has a triphasic distribution

Rapid distribution phase (α) :

In this phase, the drug is distributed to highly vascular regions.

$t^{½}$ α is 1 min.

Slow disappearance phase (β) :

The drug is distributed to slowly equilibrating tissues.

$t^{½}$ β is 9.6 min.

Slow transformation and excretion phase (δ) :

$t^{½}$ is δ is 1.6 hrs

Clearance is 0.95 litres per minute

Availability :

a) 5% heavy 2 ml ampoules which contain 50 mg of lignocaine / ml with 75 mg – 100 mg of dextrose
b) 2% ligcocaine (xylocard) without preservative – 50 ml vial for intravenous use
c) 2% lignocaine – plain – 30 ml vial –contains methyl and propyl paraben as preservative
d) 4% lignocaine with 1 in 200000 Adrenaline – 30 ml vial.
e) 4% lignocaine viscus
f) 4% lignocaine aqueous solution
g) 10% lignocaine spray
h) 2% lignocaine Jelly
i) 2% lignocaine ointment
j) 5% lignocaine ointment

Pharmacodynamics :

Local actions :

Causes nerve blockade with loss of pain and temperature sensation, touch, motor power and vasomotor tone in the region supplied by the nerves blocked.

Systemic actions :

Result of systemic absorption from the site of administration or intravenous administration

Cardiovascular system :

It has a stabilizing effect on the cell membranes of cardiac tissue.

Lignocaine depresses myocardial automaticity by antagonizing the spontaneous phase IV depolarization and reduces the duration of effective refractory period.

Myocardial contractility and conduction velocity are depressed at higher concentrations.

These effects result from direct cardiac muscle membrane changes (ie.) cardiac sodium channel blockade.

It stabilizes the membrane of damaged and excitable cells, tending to suppress ectopic foci.

Respiratory system :

Lignocaine depresses hypoxic drive (the ventilatory response to low P_aO_2).

Apnea can result from phrenic and intercostal nerve paralysis or depression of the medullary respiratory center following direct exposure to the local anaesthetic agents.

Relax bronchial smooth muscle.

Intravenous lignocaine may be effective in blocking the reflex bronchoconstriction associated with intubation.

Vascular smooth muscle :

Produces vasodilatation

Central nervous system :

Produces a sequence of stimulation followed by depression. Produces sedation on intravenous administration.

Intravenous administration decreases cerebral blood flow and attenuates the rise in intracranial pressure that accompanies intubation.

Infusion of lignocaine is capable of reducing the MAC of volatile anaesthetics by 40%.

Musculoskeletal :

Lignocaine is myotoxic leading to lytic degeneration, edema and necrosis.

Haematological :

It decreases coagulation and enhances fibrinolysis

Indications :

1. For infiltration block, peripheral nerve blocks, epidural, spinal and topical anaesthesia & intravenous regional anaesthesia.
2. Antiarrythmic :

Lignocaine is a class IB antiarrythmic.

Ventricular tachyarrythmias

Arrythmias following acute MI during cardiac surgery

In digitalis toxicity – because it does not worsen AV – block

3. Prevention or treatment of increases in intracranial pressure during intubation
   - antitussive effect may be the reason.
4. Reflex induced bronchospasm is also attenuated by iv administration of lignocaine
5. Suppresses noxious reflexes such as coughing & sympathetic stimulations associated with endotracheal suctioning and intubation.
6. Used as an antiepileptic agent intravenously
7. Used intravenously as an analgesic for certain chronic pain states
8. Used as a supplement to general anaetheisa.

Contraindications :

Hypersensitivity

Should not be used with vasoconstrictor in digits of hand, feet and penis

Stokes Adams syndrome, severe degree of heart block

Doses :

Maximum recommended dose :

a) Plain - 3 mg / kg

b) with adrenaline- 7 mg / kg

c) for reflex suppression - 1.5 mg / kg iv.

Drug interactions :

β Blockers :

Coadministration of betablockers, increases serum levels of lignocaine and its toxicity by decreasing lignocaine's metabolism.

Anticonvulsant agents :

Increases lignocaine's metabolism

Non depolarizing muscle relaxant

Blockade is potentiated by lignocaine

Opioids and α_2 adrenergic agonists :

Potentiate lignocaine's pain relief

Antiarrythmic agents

Potentiate the cardiac effects of lignocaine

Toxicity :

Mostly due to systemic absorption of locally administered lignocaine or due to accidental intravenous administration of large doses of lignocaine.

The central nervous system is mostly vulnerable.

Blood levels and symptoms :

4 µg / ml : Light headedness, tinnitus, circumoral and tongue numbness (anticonvulsant and antiarrhythmic activity)

6 µg / ml : visual disturbances

8 µg / ml : muscular twitching

10 µg / ml : convulsions

12 µg / ml : Unconsciousness

15 µg / ml : Coma

20 µg / ml : respiratory arrest

26 µg / ml : cardiovascular collapse

Treatment of toxicity :

Continuous monitoring of CVS and RS status helps to identify the toxicity earlier.

- If convulsions occur barbiturates or benzodiazepines can be given.
- Succinylcholine 1 mg / kg to paralyse the patient and aids in controlling the seizures.
- Cardiac toxicity like fibrillation can be treated by defibrillation
- Ventilatory support – 100 % oxygenation, intubation etc.,
- Maintain B.P. by rapid infusion of I.V. fluids, use of vasopressors and put the patient in Trendelenberg's position.
- Maintain fluid and electrolyte balance.

Adverse effects :

1. Allergic and hypersensitivity reactions

   Due to the preservative used – methyparaben

2. CVS :

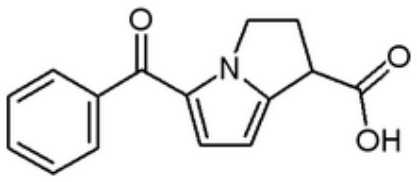
   Bradycardia, hypotension

PHARMACOLOGY OF KETOROLAC

Ketorolac trimethamine is a non-steroidal anti-inflamatory drug(NSAID) in the family of pyrrolo-pyrrolo derivative, used as an analgesic, antipyretic and anti-inflammatory. Ketorolac acts by inhibiting bodily synthesis of prostaglandins. Ketorolac in its oral and intramuscular preparations is a racemic mixture of R-(+)(which is the salt 1H-Pyrrolizine-1-carboxylic acid,5-benzoyl-2,3-dihydro- ketorolac) and S-(-) (which does not have the 1H-Pyrrolizine-1-carboxylic acid,5-benzoyl-2,3-dihydro group) ketorolac. It is one of the few NSAIDS approved for intravenous administration.

Chemistry

Ketorolac contains a chiral carbon in the β-position of the propionate moiety. As such there are two possible enantiomers of ketorolac with the potential for different biological effects and metabolism for each enantiomer.



Mechanism of action

The primary mechanism of action responsible for Ketorolac's anti-inflammatory/antipyretic/analgesic effects is the inhibition of prostaglandin synthesis by competitive blocking of the the enzyme cyclooxygenase (COX). Like most NSAIDs, Ketorolac is a non-selective cyclooxygenase inhibitor.It mainly acts peripheraly than central.

As with other NSAIDs, the mechanism of the drug is associated with the chiral S form.

Pharmacodynamics:

After IM injection maximum plasma concentration of ketorolac was achieved with in 45 to 60minutes and the elimination half time is 5hours. Protein binding exceeds 99% and clearence of this drug is decreased compared to with that of opioids. Clearence is furthur decreased in elderly individuals and the dose of the ketorolac less than that given to younger patients. Ketorolac is metobolised principly by glucuronic acid conjugation and excreted unchanged in urine. Plasma t ½ is 5-7hours. Urinary excretion accounts for about 90% eliminated drug.

AVAILABLE ROUTES:

Ketorolac avilable as Oral, IM, IV formulations.

DOSAGE:

Ketorolac 30mg IM, produces analgesia that is equivalent to 10mg of morphine and 100mg of meperidine.15-30mg im or iv every 4-6hours (max. 90mg/day). Orally it is used in a dose of 10-20mg 6hourly for short term management of moderate pain. Continious use for more than 5days is not recommended.

Indications

Ketorolac is indicated for short-term management of pain mainly, postoperative pain and musculoskeletal pain. It canbe used with opioid analgesic in general anaesthesia and as adjuvant for LA in IVRA.

Contraindications

Ketorolac is contraindicated against patients with a previously demonstrated hypersensitivity to ketorolac, and against patients with the complete or partial syndrome of nasal polyps, angioedema, bronchospastic reactivity or other allergic manifestations to aspirin or other non-steroidal anti-inflammatory drugs (due to possibility of severe anaphylaxis).

ADVERSE EFFECTS	
Body system	**Effects**
General	Edema. Less frequently, hypersensitivity reactions (such as anaphylaxis, bronchospasm, laryngeal edema, tongue edema, hypotension), flushing, weight gain, or fever. Very infrequently, asthenia.
Cardio vascular.	Hypertension. Less frequently, palpitation, pallor, or syncope.
Dermatologic	Rash or pruritus. Less frequently, Lyell's syndrome, Stevens-Johnson syndrome, musculo-papular rash, exfoliative dermatitis, or urticaria.
Gastro intestinal	Nausea, dyspepsia, gastrointestinal pain, constipation, diarrhea, flatulence, gastrointestinal fullness, vomiting or stomatitis. Less frequently, peptic ulceration, gastrointestinal hemorrhage, gastrointestinal perforation, melena, rectal bleeding, gastritis, eructation, anorexia, or increased appetite. Very infrequently, pancreatitis.
Hematopoetic and lymphatic.	Purpura. Less frequently, postoperative wound hemorrhage, thrombocytopenia, epistaxis, or anemia. Very infrequently, leukopenia or eosinophilia.
Neurological	Drowsiness, dizziness, headache, sweating, injection site pain. Less frequently convulsions, vertigo, tremors, abnormal dreams, hallucinations, or euphoria. Very infrequently, paresthesia, depression, insomnia, inability to concentrate, nervousness, excessive thirst, dry mouth, abnormal thinking, hyperkinesis, or stupor

Respiratory	Less frequently, dyspnea, asthma and pulmonary edema. Very infrequently, rhinitis or cough.
Urogenital	Less frequently, acute renal failure. Very infrequently polyuria or increased urinary frequency

Warnings and precautions

The most serious risks associated with ketorolac are, as with other NSAIDs, gastrointestinal ulcerations, bleeding and perforation; renal events ranging from interstitial nephritis to complete renal failure; hemorrhage, and hypersensitivity reactions.

As with other NSAIDs, fluid and solute retention and edema have been reported with ketorolac; ketorolac elevates liver protein levels; it also inhibits platelet aggregation and may be associated with an increased risk of bleeding.

It should be noted that when administered intraveinously through the same IV catheter as Morphine the two drugs have been known to sometimes combine to form a precipitate in the IV, which may block the line. Line flushing with a syringe of saline can push the blockage through.

Cautions

Ketorolac is not recommended for pre-operative analgesia or co-administration with anaesthesia because it inhibits platelet aggregation.

Ketorolac is not recommended for obstetric analgesia because it has not been adequately tested for obstetrical administration and has demonstrable fetal toxicity in laboratory animals.

Ketorolac has been co-administered with meperidine and morphine without apparent adverse effects.

Ketorolac is not recommended for long-term chronic pain patients.

MATERIALS AND METHODS

This is a prospective double blind study conducted at Government Rajaji Hospital attached to Madurai Medical College.

After approval by the ethical committee 50 patients of ASA grade I & II age between 15-70 years who came for upper limb surgeries which lasting for less than 60 minutes were included in this study.

Patients with history of allergic to local anaesthetics, sickle cell disease, raynaud's disease, scleroderma, local infection, pagets disease and patients with inadequate starvation < 6 hours and patients who had contraindication to ketorolac were excluded from this study. Preanaesthetic evaluation was done.

All patients were premedicated with Inj. Midazolam 2 mg IM 45 minutes before surgery. Resuscitation equipment and drugs were kept ready. Initial PR, BP, SPO2 were estimated continuously.

A 22 G cannula was placed intravenously as distal as possible in the arm to be anaesthetized. Venous access is established in the opposite arm to allow administration of fluids or drugs if necessary. The double tourniquet was applied on the arm with generous layers of padding, ensuring that no wrinkles are formed and the tourniquet edges do not touch

the skin. The arm was exsanguinated by using Esmarch bandage. If this was impossible, exsanguination was achieved by elevating the arm for 2-3 minutes while compressing the axillary artery.

The proximal tourniquet was inflated to at least 100 mm Hg higher than the patients systolic blood pressure. Before injecting local anaesthetic, radial pulse was palpated and confirmed that there was no pulse. The local anaesthetic is then injected slowly over 90 secs. A standard volume of 40 ml of 0.5% lignocaine or 40 ml of 0.5 mg ligcocaine with ketorolac was injected. Patients were divided into two groups according to the drug which they received. Group A patients received 40 ml of 0.5% lignocaine and group B patients received 40 ml of 0.5% lignocaine with 20 mg of ketorolac. After achieving surgical anaesthesia, the distal tourniquet which overlies part of the anaesthetized arm was inflated and the proximal one was deflated. After that the surgeons were allowed to proceed.

Intraoperatively PR, BP, SPO2, signs of drug toxicity were monitored regularly. If patient complained of tourniquet pain, they were supplemented with Inj. Midazolam IV (In titrated doses, max. upto 2 mg) and intercostobrachial N block with local infiltration around the cuff. The cuff was not deflated until 20 minutes after local anaesthetic injection even if surgery was completed before 20 minutes. Cuff deflation was performed in

cycles with deflation / inflation times of less than 10 seconds until the patient no longer exhibits signs of systemic toxicity. Patients were observed for 30 minutes after surgery.

Intraoperatively the following parameters were noted :

Onset action with sensory and motor

PR, BP, SPO2 were monitored regularly at frequent intervals.

Duration of surgery

Need of supplementation

Side effects

Duration of blockade after cuff deflation both sensory & motor

Post operatively the following parameters were noted

Time to first analgesic need.

OBSERVATION AND RESULTS

In my study totally 50 patients were studied. Patients were divided into two groups according to the drug which they received. Group A patients received 40 ml of 0.5% lignocaine and group B patients received 40 ml of lignocaine with ketorolac 20mg. Computer Analysis of Statistical data was done utilizing Epidemiological Information Package (EPI 2003) developed by World Health Organisation. Frequencies, percentages, mean, S.D. and 'p' values were calculated using this package.

DEMOGRAPHIC DATA

Table 1 : Age Distribution

Age Group	Study Group		Controls	
	No.	%	No.	%
<20	4	16	2	8
20-29	12	48	11	44
30-39	4	16	5	20
40-49	2	8	-	-
50 & above	3	12	7	28
Total	25	100	25	100
Mean S.D. Range	28.4 12.5 10-55		35.1 15.7 16-70	
'p'	0.0692 (Not significant)			

Comments:

The difference between the group with respect to age is not statistically significant. Hence the groups are comparable with respect to age.

Table 2 :Comparison between groups with respect to Sex

Sex	Study Group		Controls	
	No.	%	No.	%
Male	10	40	12	48
Female	15	60	13	52
P	0.7757 (Not significant)			

The difference between the group with respect to sex is not statistically significant. Hence the groups are comparable with respect to sex.

Table 3 : Comparison between groups with respect to Weight

Weight in kg	Study group	Control group
Range	42-64	46-68
Mean	52.9	55.3
S.D.	5.8	5.2
P	0.1443 (Not significant)	

The difference between the group with respect to weight is not statistically significant. Hence the groups are comparable with respect to weight.

Table 4 : Onset of Sensory blockade

Onset of sensory in minutes	Study group	Control group
Range	2-7	2-7
Mean	3.64	4.28
S.D.	1.15	1.62
'p'	0.2940 (Not significant)	

The onset of sensory blockade in study group and control group were 3.64+/- 2.3mins and 4.28+/- 3.24minutes respectively. Though the effects of ketorolac appears to be superior, the effect was not statistically significant. The effects were almost same.

Table 5 :Onset of motor blockade

Blockade motor in min	Study group	Control group
Range	3-11	5-15
Mean	7.12	9.48
S.D.	1.66	2.73
'p'	**0.0014 (Significant)**	

The onset of motor blockade in study group and control group were 7.12+/- 3.32 and 9.48+/- 5.46minutes respectively which was statistically significant.

Table 6 : Duration of Surgery

Duration of surgery in minutes	Study group	Control group
Range	32-71	30-76
Mean	45.72	45.48
S.D.	10.65	9.88
'p'	0.938 (Not significant)	

The duration of surgery in study group and control were 45.72+/- 21.3 and 45.48+/- 19.76minutes respectively. The difference between the groups with respect to duration of surgery is not statistically significant. Hence the groups were comparable with respect to duration of surgery.

Table 7 : Need of Supplementation in the intraoperative period due to tourniquet pain

Supplementation	Study Group		Controls	
	No.	%	No.	%
Given	6	24	16	64
Not given	19	76	9	36
'p'	**0.0103 (Significant)**			

In the study group 24% patients (6patients out of 25patietns) need supplementation due to tourniquet pain compared to 64%patients (16 patients out of 25patients) in the control group. The incidence of tourniquet pain in the ketorolac group was less and which statistically significant.

Table 8 : Duration of blockade after Cuff deflation - sensory

Duration of sensory blockade after Cuff deflation	Study group	Control group
Range	3-13	3-7
Mean	5.28	4.4
S.D.	2.67	1.22
'p'	0.4263 (Not significant)	

Table 9 : Duration of blockade motor in minutes

Duration of motor blockade in minutes	Study group	Control group
Range	5-17	5-11
Mean	9.04	7.6
S.D.	3.05	1.55
'p'	0.0933 (Not significant)	

The duration of sensory blockade after cuff deflation in study group and control group were 5.28+/- 5.34miutes and 4.4+/- 2.44minutes respectively. The duration of motor blockade after cuff deflation in study group and control group were 9.04+/-6.1minutes and 7.6+/- 3.1minutes. Though the duration of blockade found to be superior than that of control group, the difference in the effects between them were not statistically significant.

Table 10 : Time to first Analgesic (in minutes)

Time of first Analgesic (in minutes)	Study Group		**Controls**	
	No.	**%**	**No.**	**%**
≤60	1	4	25	100
61-120	9	36	-	-
121-180	15	60	-	-
>180	-	-	-	-
Range Mean S.D.	85-156 123.1 24.7		11-28 19.4 5.5	
'p'	**0.0001 (Significant)**			

The time for first analgesic requirement in study group and control group were 123.1+/-49.4miutes and 19.4+/-11miutes respectively. The differences between them were statistically significant. The lowest duration achieved in ketorolac group was 85minutes and longest duration was 156minutes.

HEAMODYNAMIC PARAMETERS AND SIDE EFFECTS

Table 11 : Mean Arterial Pressure after cuff deflation at 1minute

1" MAP	Study group	Control group
Range	90-111.33	80-104.67
Mean	109.8	103.9
S.D.	15.2	6.7
P	0.2045 (not Significant)	

Table 12 : Pulse Rate after cuff deflation at 1minute

1" PR	Study group	Control group
Range	62-104	60-94
Mean	86.2	80.7
S.D.	12.5	8.1
P	0.2463 (not Significant)	

The difference between the group with respect to mean arterial pressure and pulse rate at 1minute is not statistically significant. Hence the groups were comparable with respect to mean arterial pressure and pulse rate at 1 minute after cuff deflation. There were no side effects noted in both the groups after cuff deflation.

Table 13 : Mean Arterial Pressure after cuff deflation at 5minutes

5" MAP	**Study group**	**Control group**
Range	78.33-110.33	70-109.33
Mean	93.1	87
S.D.	9.8	6.8
P	0.3166 (Not significant)	

Table 14 : **Pulse Rate after cuff deflation at 5minutes**

5" PR	Study group	**Control group**
Range	58-99	58-92
Mean	80.8	79
S.D.	12.9	7.9
P	0.2756 (Not Significant)	

The difference between the group with respect to mean arterial pressure and pulse rate which was recorded at 5minutes after cuff deflation was not statistically significant. Hence both the groups were comparable. There were no side effects noted after cuff deflation in both the groups.

DISCUSSION

Intravenous regional anaesthesia uses local anaesthetics administered to one particular limb by occluding the arm proximally to provide conduction blockade. It must be safe, not threatening or unpleasant to the patient, allow adequate surgical access to the operative site, and cause as little disturbance as possible to the internal homeostatic mechanisms.

Intravenous regional anaesthesia has many advantages. It is simple, reliable with rapid onset and recovery. Despite these advantages intravenous regional anaesthesia has its own limitations like lack of postoperative analgesia and tourniquet pain which causes discomfort to the patient. In this study, we attempted to eliminate these disadvantages by adding ketorolac as an adjuvant.

Comparison of results:

In this study both group A (lignocaine only) and group B (lignocaine with ketorolac) patients were comparable in respect of age, sex, weight and duration of surgery.

The onset of sensory blockade was similar in both the groups. But there was rapid onset of motor blockade in ketorolac group in my study. This is contrary to the findings of Andrew choyce et al, who showed that

ketorolac added to IVRA produces similar onset profile in both the groups.

Duration of blockade after cuff deflation, both sensory and motor has similar recovery profile. This results correlate with studies conducted by Scott S. Reuben et al.

Incidence of tourniquet pain which was assessed by supplementation during surgery was significantly less in ketorolac group (24%) than lignocaine group (64%) which was statistically significant. The p value is 0.0103. Similar study conducted by Scott S. Reuben et al, Duprat KM et al, James R. Hebel et al shows incidence of tourniquet pain was less with when ketorolac as an additive.

The duration of post operative analgesia which was assessed by time to first analgesic, in ketorolac group is 123.1+/-49.4minutes and lignocaine group is 19.4+/- 11 minutes. The p value is 0.0001, p <<< 0.5, which is statistically highly significant. The results correlate favourably with the studies conducted by Scott S. Reuben et al in which the mean duration of analgesia was 701+/- 133 minutes. Other study conducted by Andrew choyce et al, the mean duration of analgesia was 624+/-80minutes.

Surgical trauma results in release of intracellular contents from damaged and inflammatory cells. Nociceptor stimulation cause a neurogenic response with release of mediators such as substance P and

neurokinin A. This results in an "inflammatory soup" containing histamine, serotonin, bradykinin and metabolites of the cyclooxygenase and lipooxygenase pathways. Ketorolac inhibit the production of prostaglandins from arachidonic acid in phospholipid membranes. The result is decreased afferent nociceptive signals arising from the site of surgery. Whether interfering with the synthesis of inflammatory mediators has a preemptive analgesic role in preventing sensitization of nociceptors remains controversial. The role of ketorolac in the management of postoperative pain is well established. Clinical studies have demonstrated an enhanced analgesic effect from ketorolac when concentrated at a peripheral site compared to the systemic administration of the same drug. This would suggest a predominantly peripheral site of action. It is interesting to note that the plasma half-life of ketorolac is four to six hours yet the duration of analgesia reached a plateau at over ten hours. It may be that by concentrating the dose of ketorolac at the site of surgery, either as part of IVRA or wound infiltration, the resulting analgesic benefit is longer lasting than the same dose administered parenterally. Presumably there is a persistent drug level in the tissues, and this coupled to the lower dosage could result in reduced systemic side effects.

Considering all the above said factors ketorolac in the dose of 20 mg can be used as a adjunt for intravenous regional anaesthesia with improved duration of postoperative analgesia duration and decreased incidence of tourniquet pain.

CONCLUSION

Ketorolac 20 mg which was added to lignocaine for IVRA provides

1. Less incidence of tourniquet pain
2. Increases the duration of post operative analgesia
3. No significant increase in side effects and there was no haemodynamic changes.

BIBLIOGRAPHY

1. Brown BL, Fink BR. The history of neural blockade and pain management. Holmes CMCK. Intravenous regional neural blockade. In : Cousrns MJ, Briden baugh PO (Eds) Neural Blockade in clinical anesthesia and Management of pain, 3rd ed. Philadedphra : Lippincott- Raven, 1998 : 3-34 & 395 – 410.
2. Good man and Gillman's text book of pharmacology
3. Text book of pharmacology – K.D. Tripathy 6th edition
4. Reuben SS, Steinberg RB, Kreitzer JM, Duprat KM. Intravenous regional anaesthesia using lignocaine and ketorolac.
5. Gentili M, Bernard J-M, Bonnet F. Adding clonidine to Lignocaine for intravenous regional anaesthesia prevents tourniquet pain. Anaesthesia Analgesia 1999, 88 : 1327 – 30.
6. Lundell J, Silverman DG, Brull SJ et al : Effect of local injection of ketorolac on post-burn by peralgesia. Anaesthesiology 1994, 81 : A960.
7. Reuben SS, Duprat KM : Comparison of wound infiltration with ketorolac versus intravenous regional anaesthesia with ketorolac foro postoperative analgesia following ambulatory hand surgery. Regional Anaesthesia 1996, 21 : 565-568.

8. Andrew choice, Philip peng. A systemic review of adjuncts for intravenous regional anaesthesia for surgical procedures.

9. Elhakim M, Sadek RA : Addition of atracurium to Lignocaine for intravenous regional anaesthesia. Acta Anaesthesia Scandinavica 1994 ; 38 : 54-4.

10. Armstrong P, Brockway M, Wildsmith JA. Alkalinisation of prilignocaine for intravenous regional anaesthesia. Anaesthesia 1990 ; 45 : 11-3.

11. G. Edward Morgan, Jr. Maged S. Mikhail, Michael J. Murray ; Clinical Anesthesiology. 4th edition

12. Ronald D. Miller, Miller's Anesthesia 6th edition.

13. Keith G. Hillman, Iain H.W. Oxford Hand book of Anaesthesia.

14. Hoffman V, Vercauteren M, Vansteenberge.A, AdviaensenH. Intravenous regional anesthesia. Evaluation of a different additives to prilocaine. Acta Anaesthesia Belg. 1997 ; 48 ; 71-6.

15. A Calovschi I, Cristea T, Margarit S, Gavrus R. Tramadol added to Lignocaine for intravenous regional anesthesia. Anesthesia Analgesia 2001 ; 92, 209-14.

16. James R. Hebl, Local Anesthetic Adjuvants for Neuraxral and peripheral Blockade.

17. Eisenach JC, Dekock M, Klimscha W : alpha 2 – Adrenergic agonists for regional anaesthesia. Anesthesiology 1996, 85 : 655-674.

18. A. Turan, B. Karamanlyog M, D. Memis, G. Kaya and Z. Paukcy ; Department of Anaesthesiology and Reanimation, Trakya University, Turkey.Intravenous Regional Anaesthesia Using Prilocaine and Neostigmine

19. Stephan C. Marsch, MD, D Phil, Mathias Sluga, MD, Wolfgang studer, MD, Jonas Barandun, MD, Domenic Scharplatz, MD and wolf gang Ummentioter MD, From the Departments of Anaesthesia and surgery, Switzerland. 0.5 % versus 1.0% 2 – chloroprocaine for Intravenous Regional Anaesthesia : A prospective randomized, Double – Blind Trial.

PROFORMA

KETOROLAC AS AN ADJUNCT IN IVRA

Name : Age / Sex :

IP No. : Weight :

Diagnosis : ASA Risk :

Surgery :

Premedication :

1. Onset of action : Sensory :

   Motor :

2. Side effects noted :

3. Duration of surgery :

Time	Pre	5	10	15	20	30	40	60	75	90	120
HR											
BP											

4. Supplementation :

5. Duration blockade after cuff deflation : Sensory :

   Motor :

6. Post operative :

   Time to first analgesic :

MASTER CHART

S. No.	Name	Age	Sex	IPNo.	Weight	Diagnosis	Surgery	Onset of sensory (mins)	Onset motor(mins)	Duration of surgery(mins)	Supple mentation	Sensory(mins) recovery	Motor(mins) recovery	First analgesic(mins)	MAP (1st min) mm Hg	PR (1^{st} min)	MAP (5^{th} min) mm Hg	PR (5^{th} min)
1	Indhirani	21	F	369282	46	Gang	Exci	4	7	40		5	9	105	100	94	73	84
2	Arumugam	20	F	85561	52	Gang	Exci	3	6	38	Y	4	10	148	99	69	80	58
3	Indumathi	31	F	187213	54	Gang	Exci	4	6	42		7	9	126	108	88	90	82
4	Backiyam	30	F	153544	52	Gang	Exci	2	3	32		4	7	110	117	102	106	90
5	Muthuraman	55	M	339880	55	R Radius	ORIF	4	9	52	Y	10	17	148	123	94	73	88
6	Ayerna	23	F	107601	56	Gang	Exci	3	6	41		5	6	85	124	101	106	96
7	Muniyappan	28	M	154870	62	Gang	Exci	5	9	40		9	11	156	110	86	86	74
8	Krishnakumar	16	M	401202	47	Gang	Exci	4	7	35		13	16	131	111	72	76	62
9	Kavitha	30	F	21176	51	Ext.Poi.I	TT	5	9	56	Y	4	7	125	106	79	86	72
10	Pounamma	47	F	20619	42	Gang	Exci	4	6	47		4	8	138	93	89	80	80
11	Ammasi	50	M	169032	54	Gang	Exci	5	7	35		11	14	126	106	99	96	94
12	Gurunathan	55	M	337463	62	RA FA	SSG	3	7	58		3	9	152	100	69	93	64
13	Selvi	20	F	329078	56	Gang	Exci	2	6	43		3	7	106	117	82	106	79
14	Muthulakshm	20	F	351114	51	ETI	Repair	3	8	71		4	9	95	123	102	93	96
15	Jeyamani	45	F	349412	45	FTI	Repair	2	9	61		5	11	111	111	96	96	90

16	Chitrakala	21	F	37151	56	Gang	Exci	4	8	41		4	7	132	90	96	99	90
17	Alagar	27	M	248205	58	LFA	Exci	3	6	34		5	9	152	98	64	96	60
18	Balamurugan	17	M	356682	51	C F3-F5	R SSG	4	7	54		5	11	132	93	72	83	66
19	Mahalakshmi	24	F	2404998	50	Gang	Exci	2	5	36		4	8	126	94	86	91	82
20	Gomathy	35	F	1016979	55	Gang	Exci	4	6	43		3	5	114	104	62	90	60
21	Ahmed	16	M	311385	48	E Rt Ra	Exci	4	7	68		4	9	127	113	104	104	99
22	Murugan	24	M	205282	64	F Radi	K-WF	3	6	51		5	7	108	126	90	100	94
23	Bairavi	18	F	336048	46	Gang	Exci	7	11	36		3	5	97	103	86	94	92
24	Divya	22	F	308025	47	Gang	Exci	4	9	42		5	9	138	98	92	92	87
25	Senthil kumar	21	M	326947	61	X Rt FA	Exci	3	8	47		3	6	145	120	81	110	80

S. No.	Name	Age	Sex	IPNo.	Weight	Diagnosis	Surgery	Onset of sensory (mins)	Onset motor(mins)	Duration of surgery(mins)	Supple mentation	Sensory(mins) recovery	Motor(mins) recovery	First analgesic(mins)	MAP (1st min) mm Hg	PR (1^{st} min)	MAP (5^{th} min) mm Hg	PR (5^{th} min)
1	Pandiyarajan	21	M	203994	46	Gang	Exci	4	14	35		3	6	16	80	80	76	80
2	Kamatchi	30	F	206657	52	Gang	Exci	6	15	40		4	7	10	90	79	86	78
3	Murugesan	20	M	223273	54	Lip elbo	Exci	3	7	37		5	7	24	100	84	87	82
4	Vellaisamy	29	M	199322	52	F BB F	ORIF	5	9	76					90	94	83	92
5	Karupanan	50	M	426816	55	Neu Fib	Exci	7	11	47		4	7	14	93	74	83	74
6	Muthumari	19	F	199641	56	F BB FO	Met Ex	3	5	51	Y	7	9	28	104	82	93	80
7	Shankar	23	F	56168	62	Gang	Exci	7	11	41		4	6	19	100	84	80	82
8	Valarmathy	32	F	196914	47	F T I	Repair	3	6	54	Y	4	7	25	93	70	86	71
9	Deepika	28	F	64255	51	Gang	Exci	7	13	30	Y	3	5	17	86	86	90	88
10	Ravi	35	M	195160	42	Gang	Exci	4	9	53	Y	5	7	23	96	90	86	88
11	Pandiyammal	32	F	158323	54	Gang	Exci	3	9	35		5	9	27	88	60	80	58
12	Veeramani	23	M	181148	62	RA FA	SSG	7	13	56	Y	7	9	11	97	76	86	82
13	Selvi	23	F	329878	56	Gang	Exci	3	9	33		3	5	14	93	76	86	72
14	Sureshkumar	16	M	190937	51	ETI	Repair	4	11	47	Y	4	9	28	93	86	80	82
15	Karupayee	70	F	404027	45	FTI	Repair	3	7	41	Y	4	9	28	100	90	86	90
16	Mayammal	30	F	194209	56	Gang	Exci	5	11	45		3	5	14	97	92	91	81
17	Rama	65	f	403891	58	LFA	Exci	4	9	51	Y	4	8	13	100	64	93	60

18	Veeralakshmi	27	F	202952	51	C F3-F5	R SSG	3	8	48		5	7	21	100	64	93	60
19	Bakkarmastan	64	M	438434	50	Gang	Exci	7	14	38		5	9	14	94	76	93	76
20	Krishnan	55	M	197028	55	Gang	Exci	4	9	52	Y	5	7	20	93	86	86	80
21	Ravichandran	24	M	443113	48	E Rt Ra	Exci	3	7	41	-	3	9	26	100	80	99	78
22	Rajkumar	29	M	437328	64	F Radi	K-WF	2	6	36	-	3	7	14	80	82	70	80
23	Muthiah	28	M	232714	46	Gang	Exci	3	8	44	Y	4	9	16	96	78	96	76
24	Maryvictoria	45	F	226944	47	Gang	Exci	4	8	50	Y	5	9	12	83	82	83	83
25	Ramadurai	55	M	437318	61	X Rt FA	Exci	3	8	56	Y	7	9	28	103	86	967	82